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BIO-PHILOSOPHY.

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From the author,
815 Marcy Avenue, Brooklyn, N.Y.

BIO-PHILOSOPHY:

OR,

The Meaning of Comparative Physiology, Comparative Psychology, and Organic Evolution:

BY

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JOEL N. ENO, A.M.

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BIO-PHILOSOPHY: OR, THE MEANING OF COMPARATIVE PHYSIOLOGY AND BIOLOGICAL EVOLUTION.

The general force or energy which shapes matter is the mutual gravitative attraction of the particles toward each other; if they are free to move, tending to draw them toward a common centre, with the spherical form as a result.

There is also special shaping-force as, for example, the force of crystallization; each of the point-systems of the crystal possessing in the nucleus a "centre of gravity;" and the whole crystal as many centres of gravity as it has point-systems. "A crystal consists of a finite number of interpenetrating regular point-systems which all possess like and like-directed coincidence-movements,"—each point-system formed of similar atoms, and being built up from a number of interpenetrating space-lattices, each consisting of three sets of parallel planes which enclose parallelopipeda; the number of point-systems is six, forming only thirty-two classes of crystals. Such is the inexorable fixity of physico-chemical types, in crystallization. But we turn from inorganic petrified forms to the organic.

When we study vital force,—the essential force which shapes living beings, and transforms non-living matter into living matter, we find, instead of immediate hardening in molds into fixed and unchangeable shapes,—its distinctive characteristic is adaptive variation from type, a natural adaptation to the conditions in which the plant or animal lives, and to all which constitutes its environment; the variation being termed a response. Protoplasm is the dominant factor in living development; both the lowest plant and the lowest animal starting from a single cell of protoplasm, consisting of protein (a chemical composition of one or more forms of a complex compound of carbon, hydrogen, oxygen, and nitrogen (C_{40} H_{31} O_{12} N_5), and water, for which protoplasm has a powerful attraction; for water is a primal necessity of protoplasm, its life depending upon it. As there is only one essential subject of physiology,—namely, the behavior of protoplasm, we begin it here. The first of the differentiations of the original cell is the protective covering or cell-wall; the cell producing on its external surface smaller, closer-set and denser protoplasts (or protoplasmic units) than those within. Naked cells live in water, and so are saturated by it; but cells with walls have a vacuole or cavity occupying the greater part of the interior, and the hydrostatic pressure keeps the cell full or turgid with water, through which also a plant receives in solution the substances from which it manufactures food; certain cells of the interior being differentiated for the absorption of water, as from the soil. There is no fundamental difference between the living protoplasm of plants and that of animals, there being such forms as Volvox and Myxomycetes which cannot with certainty be determined whether they belong with plants or animals. Plants in general not being able to travel to seek food, have a mechanism by which they can manufacture food from the inorganic, gaseous, and liquid matter which they absorb as raw material; not merely the absorption of the solution in water, and the squeezing out by internal pressure of waste and insoluble material, processes which suggest digestion and excretion, but a mechanism by which the absorbed materials are converted into substances that can nourish protoplasm, both vegetable and animal; namely, the chlorophyll apparatus, formed of corpuscles impregnated with a green coloring matter imbedded in the protoplasm. The algae (such as seaweed) being immersed in water and having only a gelatinous cell-wall absorb food-material all over; and they with the higher plants, having chlorophyll, are capable of manufacturing carbo-hydrates by the use of the carbon-dioxide absorbed from the air, in the presence of light; the fungi, being devoid of chlorophyll, are dependent on carbo-hydrates ready-made by other plants, or, exceptionally, derived from animal sources. In the higher plants, the cells of the foliage-leaves and the bark of young twigs are the manufacturers; these plants have a power not clearly understood, of converting nitrogen drawn from the soil, especially in the form of nitrates, into proteids, and of forming sugar and starch which is stored plant-food, and proteids as albumoses and globulins from the crude carbo-hydrate material. Under the increased influence of the sun in the spring, watery sap travels up through the spaces of a tree's sap-wood to supply the twigs and buds rapidly drained by evaporation, but chiefly probably by pressure caused by the turgid condition and the rapid absorption of water by the roots; when the food-material thus carried up arrives, the leaves unfold and take the more active part in making carbo-hydrates; growth is a necessity incidental to the enormous multiplication of protoplasts under the above favoring conditions. The petals, sepals, pistils and stamens of the flower, as well as the tendrils and scales are modifications or differentiations of the leaf; the shoot from which it springs must, for the performances of its functions have light; hence we find it in the sprout from the seed strongly seeking light; the root springing from the seed with like avidity seeks water, which it must find in the opposite direction; the very sunlight which draws up the sprout draws by evaporation from the immediate surface of the soil the water; and the more surface exposed to the sunlight in the foliage, the more the roots must spread and sink to seek water and food-material in water-solution below. The quantity of growth of the trunk or stem depends mainly on the quantity of available food-material in the soil where it grows, which goes to thickness in the open, while among close-set trees the stem must grow higher proportionately in order to obtain sufficient lighted space for the performance of its foliage-functions; plants must also respire oxygen, absorbing it in the dark and exhaling it in the sunlight, exactly the reverse of the day-absorption and night-exhalation of carbon-dioxide. Finally, the seed consists of a germ surrounded by proteid substance ready for use as the food of the starting sprout. The force in the great tree makes conquest of gravitation, growing upward and carrying up with it tons of matter, in direct opposition to gravitation, and the shape of its trunk is cylindrical, not spherical nor with crystalline angles; yet it has a principle of symmetry, and its leaves have a balanced arrangement, and a typical form for each genus, with minor variation for each species, even a modification of the latter to adapt it to the peculiar position of a leaf on the tree. A marked example of plant-adaptation is the Drosera or sundew, which grows on soil so poor that only mosses can live with it, but moist; hence, its small roots find scarcely anything to absorb except water, and the plant must depend on the atmosphere for sustenance, and has differentiated its leaves into traps for seizing objects which fall upon them, closing on those which are moist as they come in contact with its acutely sensitive glands, or in case of the Venus' Flytrap, the filaments on the upper surface of each of the two lobes of the leaf.

Not only is vital force able to press other forces into its service, but even material form may be a secondary and evanescent matter. An extreme example of self-variation through vital force is the amoeba, the simplest prototype of animal life, and in the simplest form, to appearance a viscid drop, varying in different species from one one-hundredth to one-eighth inch in diameter. Without an arm or tentacle for catching the food substances around it, it improvises such by protruding portions of its substance: the food met with and grasped, it is without a stomach-receptacle, and improvises one by wrapping its substance completely around objects of suitable size till the nutriment is absorbed, determining its shape by its own endeavor, a prophecy of at least muscular volition: a remarkable potentiality of self-adaptation for self-needs; and evincing the power or capability of even the simplest rudiment or slight beginning of mind to make use of even the rudest instruments, as well as its large degree of independence of fixed form or permanent organs. Its extreme plasticity, though it be useful to the execution of a single and simple desire, is replaced in the higher animals by a higher kind of self-adaptation, qualitative, not quantitative; accompanying mental plasticity or versatility; instead of a change of form, a change of the use of permanent organs; a change due to the mind, intellectual more than muscular volition; thus the hands of Edison are very like the hands of other men; the difference is in the inventiveness of his mind.

The upward progress or development from rank to rank of living beings, from the single cell, reveals a principle of specialization, or branching off from a common basis or beginning, by an unusual development of a particular function or functions. The susceptible state or condition of protoplasm in plants when it responds to a change in external influences or in the adjacent protoplasm, is called irritability; and the change which initiates the response is called the stimulus; for example, light or heat effects. The nature of the stimulus does not in any way determine the character of the response, but this is conditioned by the mechanism which the stimulus sets in action. The stimulus is only a releasing cause, and were not the energy provided by the living protoplasm, no reaction would occur; the reaction being due to the fact that the matter is living matter. When the stimulus acts upon protoplasm, this substance is decomposed, and in its destruction energy is liberated, by means of which the response is made. Every living cell of a plant is in reality, in the broad sense defined above, an irritable structure. Though in some plants the response to stimulus is movement, it is a mistake to consider motor organs as specially irritable organs; tendrils, the motile leaves of Venus' flytrap, and the tentacles of Drosera, though looked upon as sensitive organs par excellence, are; many of them inferior in sensitiveness to structures whose reaction is less evident. Though in plants there is no structure corresponding to nerves of animals the place of response may be distant from the place of stimulus, whose propagation may take time, varying from the sensitive plant in which the final response follows in a fraction of a second after the stimulus; usually longer, even minutes or hours, in other plants. It seems a long look from plant irritability and its motile reaction, to the sensory and the motor system of human nerves, but evolution seems to feel its way, as by experiment, to the fittest instruments, at the same time providing for the self-preservation and continuance of the species, by renewal and reproduction. The plant has its indispensable work of manufacturing earthy into vegetable substance, which in its turn is assimilable by various classes of animal life, as earthy substance is not: but evolution is involved chiefly through the variation and reproduction of the kind, rather than the conservation of the individual; and the lowest animal has much in common here with the vegetable, and taken as a starting-point, hastens along the discussion by the shortest line. The amoeba-sphere has in itself, as it were, a world of possibilities not only of self-variation into improvised organs, but also of improvised reduplication, when it has grown to a certain size or stage; its nucleus or life-center becomes double, and the two nuclei pushing apart, gradually attenuate the connecting plasm to a thread, becoming at last, twins, and separate. This self-production of two selves gives a sort of side-wise immortality or life-continuity through numberless repetition of the process; but as we might ask,—what avails eternity of duration to the unconscious rock? so what avails such immortality to the almost vegetable nature of the amoeba? Vegetable life and the lowest animal life represents the extreme of diffusedness of the power of life and of sensation; an organization which seems to emphasize tenacity of mere existence at the expense of mental sensibility, as by a principle of compensation; for example, some trees continue their semi-life through centuries. On the other hand, as we proceed in the upward direction to the higher and the highest animals, we note increasing concentratedness of the animal powers, by specialization, with increasing danger of cutting off the life by a blow at the seat of concentration. The principle of compensation has been caught sight of in the saying, "that which is really valuable, costs." This term does not refer to the proportion between stimulus and response of the animal to it; for a small stimulus from without causes a response disproportionately large, as a small blow will set off a powerful explosion, if the material struck be nitro-glycerine.

Every plant and every animal begins life as a single cell, derived from a previous plant or animal, and goes through an amoeba-like process of division; but reproduction as compared with growth, is a diversion of growth from the increase of the individual to the increase or perpetuation of the species; and, starting from the common protoplasmic base of both animal and plant, in the evolution upward, each affords many parallelisms of process with the other, as well as transitional or compromise forms and stages which bridge the gaps. As to the relation of the germ-cell to the parent, Lamarck held that acquired characters are transmissible to offspring: Weissmann, that the germ-plasm of the original cell is unique, not like general protoplasm, and contains the "id" or determinant of the character of the new individual; and not acquired characters, but the germ-ids themselves are transmitted from generation to generation;

Hertwig holds that germ-plasm is similar to protoplasm; Mendel, that the character of the offspring, including sex, is determined by the dominant factor in the germ, an odd number of chromosomes producing a male; an even number a female. Sex, in its general sense, means a differentuation into giving - and receiving-organs of reproduction, the former representing the male and the latter the female.

Plants may be grouped under two modes of reproduction, namely: vegetative propagation, and true reproduction; animals, in like manner. In the first, the protozoa reproduce by almost mechanical breakage or division; budding, which is an orderly or systematic rupture, is continuous in sponges and in some plants; discontinuous, in the tiger lily, zoophyte and hydra. Yet true or sexual reproduction is nearly as primitive and fundamental a mode, arising in a differentiation in one direction anabolic, or accumulative of substance, as is needed for the production of offspring, with a passive "sexual diathesis" prefiguring the female; in the other direction katabolic or substance-expending, with an appetent or seeking, active diathesis; with the result that in the lower animals, the active or male form is smaller than the female. We cross from vegetative to true reproduction through the thallophytes (bacteria, fungi, algae) among plants, and the coelenterates among animals; in the former, there is no differentiation into leaf, stem, or root; a reproductive cell (gonidium) gives rise to an organism resembling the parent plant; the protoplasm, at the end of its growth or vegetative life, either becomes quiescent and encysted in cell-walls, or is set free as a motile ciliated cell. In the primitive mould, myxomycetes, flagellates (active) and encysted (passive) both recur to the amoeboid as a compromise stage. The three stages have their representatives in permanent species; the low alga, Protococcus, divides into equal units or spores; compare amoeba. In a higher alga, Ulothrix, both large and small reproductive cells are developed; and in Ectocarpus are developed both the large sluggish (female) cells and the small, active (male) cells, a distinct beginning of the distinction between male and female. In another alga, Cutleria, the differentiation may be traced since two kinds of units result, which must unite if development is to take place, the anabolic being fertilized by the small katabolic cells. In Protococcus, the whole body, being only a single cell has reproductive power diffused throughout it; while Volvox has advanced the next step toward separate sex, the whole colony being unisexual, either male or female. In one of the brown algae (seaweeds) asexual and sexual reproduction occur at different periods in the same plant. Among protozoa occur the first distinctions among animals between "body" and reproduction cells,—"a stated antecedent of sex"; for certain units of loose colonies set adrift meet and fuse with others to form a double cell,—virtually a fertilized ovum (egg) from which, by continuous division, a fresh colony is developed. Thus in these transition-forms, there are reproductive cells, but no sexual organs; compare sponges. A different kind of transitional form appears in the alternate generation in mosses; the germ producing first a filament, then a bud from which develops the true moss; in ferns the prothallus appears transiently as a liverwort, in which are reproductive organs and an embryo whence develops the true fern: the antheridia and archegonia of such higher flowerless plants, though they produce only germ-cells called spores, are considered to represent respectively the male and female reproductive organs (stamens and carpels) of flowering plants, which produce both the large (female) and the small (male) germ-cells. Hermaphroditism, or the combination of both sexes in one individual, obtains in most plants and flowers, and in sluggish, fixed, or isolated animals and parasites; since unisexual individuals, under such conditions would remain unfertilized, and so die out; yet if we consider each stamen and carpel as a modification from a separate leaf, each by itself would be unisexual. as distinguished from the prothallus of a fern, which bears on the same expansion, both male and female organs. Compare with the flower the animal, hydra, which has near the base of its tube a rudimentary ovary; farther up the tube, a protuberance containing small cells (spermatozoa) from the simplest, most rudimentary male organ or testis. Hermaphroditism is a primitive state among the many-celled organisms, alternately male and female, and ranks lower than unisexualism, which arises through specialization of function. It is rare among birds and mammals, and exceptional among amphibians; though frogs and toads, like fishes, sometimes have an ovary and a testis side by side or one in front of the other. One of the phenomena of alternate generation is parthenogenesis or virgin conception; the organism arising from sexual generation, producing offspring unlike itself, without sexual union with a male. Such organisms in time acquire sexual organs, and from their impregnated germs the original parent form is produced. The only clear instance among animals so highly organized as the insects is in aphides or plant-lice, a large proportion of which remain in the larva state (none being males) and bring forth living young resembling themselves, and these young repeat the process, if well-fed, up to 10 or 11 successive broods of females, during the abundant food of summer; but with the scanty food of autumn, winged males appear among winged females in the last brood; sexual reproduction recurs, and the females produce fruitful eggs which retain vitality through winter and hatch in spring, long after the parents have perished. Though the queen bee produces alone successive broods of imperfect (or worker) females and their queens, the result is attributed to the persistent vitality of the spermatozoa which she received from the drones in her original and single impregnation in her youth. Parthenogenesis is a degenerate sexual reproduction; and true parthenogenesis is wholly unknown in the higher animals. Sex, in the higher embyro is evolved in the three stages, e. g. in the chick: the amoeboid, with germiparity until the fourth to the sixth day in the brooded egg; on the seventh day, hermaphroditism, but male ovules dominant in some, female in other eggs; eighth and ninth days, the female or cortical ovules disappear from the testes, and the medullary or male ovules from the ovary of the embryo, thus fixing the difference of sex; these three stages form a parallel also to the stages of historic evolution. So the human life-cycle epitomizes the history of previous evolution up to the human; though as we ascend the process recedes toward the beginning of the life-cycle, the embryonic stage, and the remarkable bodily metamorphoses which characterize low animals fall back to the early part even of that stage; and Merkle's conclusion is still found fundamentally true, that "the more highly an organism is organized the more quickly does it pass through the lower stages"; one pair of the rudimentary hermaphrodite sex-organs, either the testes or the ovaries atrophies, and the other is sufficiently developed to be distinguishable in the human embryo, toward the end of its second month; though "all attempts to determine the sex of offspring in the higher animals by treatment have failed." The result of intermixing the two sexes is variation, which seems to be a universal principle of Nature in biological evolution; self-fertilizing, which obtains among isolated hermaphrodites, e. g. cestode worms, clams, cockles, and common oysters, excludes this important factor, and mechanical division even more so, since it produces mere duplicates of the mature animal, no higher, nor with any educative period, physical or mental.

To point out the upward path of general evolution: we step from the Protozoa, or lowest animals, e. g. amoeba, to the Coelenterates, a name meaning "hollow intestine,"—because there is an inner food-receptacle; in this class, Nature seems to run riot, not only in nearly every possible mode of reproduction, but in variations and variety of form, even extending to different stages of the same animal; e. g. the larval stage of certain medusae, which until recently were reckoned as wholly distinct species; great plasticity of structure being still a characteristic. Leaving aside the digressive lines of animals, and advancing on the line leading toward man, we find the Echinoderms, with radial symmetry of form, developed from the bilateral, fixed by an external firm casing,—almost exactly intermediate in rank between the coelenterates and the higher invertebrates; like the former, they have no definite circulatory system, and no concentrated nervous system; like the latter, they have a body-cavity surrounding an alimentary canal. Related in its lower aspects to the echinoderms, is the hemichordate Balanoglossus; but in its concentration of nervous system, it approaches the vertebrates, as it has a notochord or rudimentary spinal cord in the front end of its body. Next, the fish-like Amphioxus or lancelet, having a notochord along the entire length of its body and head. Then the lung-fish explains the transition from a water-breathing animal to an amphibious one; the long drouths in its native region bringing it to air-storage and seasons of air-breathing. Yet in this seemingly remarkable transition we see that, although oxygen is one of the most active agents in changing matter, living as well as inanimate, the breathing of larger amounts of oxygen, has advantaged the amphibian very little as compared with some fishes. The next step is more important, in which a salamandrian (now fossil) links the reptiles in many points to the mammals, highest of whom is man;(the bird being a widely divergent evolution from the lizard, with feathers for scales)

The steps of advance from the lancelet to man are characterized by increasing cephalization or concentration and expansion of the nervous centre in the head; though we find the beginning of a nervous system as far back as the ganglia around the margin of medusae, which respond to irritation by promiscuous discharge of energy, causing simple contraction of the continuous muscle surrounded by the margin. A ganglion is a collection of nerve-cells, whose function is called reflex action, because the original stimulus falling on the sensory surface does not proceed in a direct line to the muscles, but through the ganglion, whence it is reflected to the muscles; that is, it is a system of co-ordination between the ingoing or sensory nerve and the outgoing or motor nerve. Localization of special sensitiveness in a particular part of the living substance is observed even in the ends of the radicles or terminal roots of plants, and is explained by Spencer,—that homogeneous protoplasm under stimulus is everywhere irritable and contractile, and where there are no nerves gives rise to visible waves of contraction, spreading from the seat of stimulation in all directions: parts more frequently stimulated than others, for example, those exposed to the action of forces differently from others, acquire polar arrangement of protoplasm, so that the molecules and lines of travel become passages of least resistance to the flow of molecular waves, and eventually habitual channels of this flow; this is in consonance with the principle of "practice makes perfect," or of strengthening an organ by suitable use, and weakening of the unused parts, resulting in a differentiation. Nerves conduct invisible or molecular waves of stimulation from one part of an organism to another, thus establishing physiological continuity without visible waves of contraction. The use of contraction of muscle to the medusa is to increase the rate and strength of swimming movements. Rising to the (echinoderm) star-fish we find the ganglia arranged around the bases of five rays; but each ray has its own system, and if cut off at the base behaves like the entire star-fish; (and also has the shaping-force and power of growth to reproduce the other rays from itself). If one of the arms is irritated, the star-fish crawls away from the source of irritation; if two arms are irritated at once it moves in a direction at right angles to a line joining the points of irritation, that is, in accordance with the mechanical principle expressed by the parallelogram of forces. The echinoderms have the power of coordinate muscular movement of rays, through connections between the ganglia, so forming a ring of nervous matter, or circular nerve-system; and advancing beyond the protozoa and coelenterates, which seem to have only the sense of feeling, have a rudimentary eye,—a lens set in pigment and supplied with a nerve, but no retina, so it can probably do little more than to distinguish light from darkness; and there is no adequate evidence that they profit by individual experience, or exhibit truly mental phenomena; about the same can be said of the true worms; a few species of medusae, mollusks, and crustaceans appear to recognize sound; mollusks and crustaceans also have eyes of some kind; snails and many species of crustaceans bear them on stalks; and the eye of the slug onchidium approaches remarkably toward the vertebrate eye in that the nerve penetrates the retina and is spread on the anterior surface; but onchidium has also the invertebrate eye, in which the optic nerve is spread on the back of the retina, and the optic rods point in the opposite direction from those in the vertebrate eye. Though insects have a complex nerve-system, especially as to ganglia, and delicacy of sense, they develop along a line widely divergent from the vertebrate. The fish-brain consists of a fore-brain, consisting of olfactory or smell lobes; a mid-brain, or optic lobes, and a hind-brain or cerebellum and medulla; the cerebellum governing and impelling or accelerating coordinate muscular movements, and the medulla is the ganglion for the reflex actions of swallowing and breathing. Instinctive, that is, conscious and adaptive, but reflex action, antecedent to individual experience, does not necessarily involve recognition of relations between the means employed and the ends obtained; only similarly performed actions under similar and frequently recurring circumstances, by all individuals of the same species, with response to a stimulus, by a perception; whereas reflex action responds, at most, by a sensation. Instinctive action seems closely connected with the perfection of the nervous mechanism for performing the instinctive act; for example, the chick, belonging to a species which uses its bill for many purposes for which we would use the hand, pecks at any small object presented before it soon after birth from an incubator egg; the child, soon after birth, will grasp a stick in its hand, as well as suck a wet rag or a rubber nipple as readily as its mother's nipple; as a calf will suck another calf's ear, as persistently as it will suck a cow's teat, apparently from some satisfaction in having an object in the mouth to excite nerves there, the result of which in the mammal is a flow of saliva; when a substance reaches a certain point in the throat, it acts as a stimulus to the reflex motor reaction, swallowing. The chick learns what is good to eat by experience, largely by a process of elimination of what to avoid, and association of impression on sight with impression on taste; thus it avoids not only the distasteful bee or caterpillar, but a fly looking much like the bee; so Morgan's incubator ducklings made swimming motions and swam when first placed in a tin vessel of water; but on the sixth morning went through the swimming motions for ten minutes before they began to discover that the tin was dry; but on the seventh morning, after squatting in the dry tin three minutes got out and waited till water was poured in. He concludes that the vast majority of associations are associations either of contiguity or of similarity of appearance; and in the latter case that the bird does not discriminate between insects having protective coloration or form like a nauseous one, and the insect mimicked, but that the illusion is perfect. Under the increased experimental study of animal reflex action, intelligence and memory, the field formerly allotted to pure instinct has narrowed. Even the primitive homing instinct and instinct of direction has many of its stories explained away by close observation. Lubbock found the ant's sense of direction dependent on the direction from which light fell upon it; and it needs to be proved that it is purely instinctive, neither dependent on coordination within nor association without the body of the creature, nor on automatic response to stimulus; an arrow will go straight if started right, so a mechanically perfect flying machine in quiet air; the predisposed tendency is ready to be set off in the chick's peck, or the suck of the young mammal, in an initial act of seeking for something, it may not know what any more than the amoeba reaching forth its pseudopod. So long seasonal migration, mainly of two of 23 orders of birds, but these the most comprehensive and highest organized orders, is attributed by Brewer to three main causes; 1, habitual manner of procuring food; 2, disposition; 3, wing-power: the prime impelling cause being the want of food; one class of these birds eat soft-winged insects, which with the exception of some very small species, are summer insects; such birds are the swallows and flycatchers; a second class get their living in freezable waters,—ice cutting off their food-supply; and incidentally, some birds of prey follow in migration the birds they prey upon. The term migration is usually applied to the autumn flight from colder or breeding regions, since it is observed of the migratory bird that it breeds at the coldest point of its migration; the return in the spring is explained by the bird's desire for its familiar breeding-place, or home; observation and memory, which are very strong in birds, being the chief guides thither-ward. Wallace explains the tropic-ward migration on the principle of the "survival of the fittest"; the best flyers migrate farthest; those who go astray in their migratory flight die; the rest live, return and propagate their kind; the poorest flyers, such as most game birds, do not migrate at all. Orientation and the exact co-ordination of wing-movements necessary for flying at all, suggest why the bird and the bee proceed in the same direction in which they started, in "a bee-line," like exact and delicate machines.

The key to the whole development of intelligence seems to lie in the amount of plasticity of mind of the creature or the species studied, in something like an inverse ratio to the earliness of the stage at which it matures; the smallest measure of capacity being quickest filled, and its contents sealed up against further inflow. Thus the chick is able to feed itself and to run about in a few hours as well as the most intelligent birds are able to do in many weeks; and can apparently see and hear as well on the first day as the puppy can on the eighteenth; while the child, "mind-blind," is sleeping about five-sixths of the time, growing from sucking at waking intervals; limited almost wholly to becoming ready for its years of mental development broader than any other animal's and far more complex; of which fact the multitude of convolutions of its brain may be taken as an index. In the bird (and below it) the cerebral hemispheres are perfectly plain and smooth, except the Sylvian fissure; in the dog type, the simplest form of true convolutions is first met with, six in number; in man, three external fundamental convolutions, crossed by two sets of transverse convolutions,—in each of the hemispheres four orders of convolutions, the first surrounding the hemispheres like a ribbon; the second consists of two marginal convolutions; the third are internal convolutions; the fourth, the largest, deepest, and least symmetrical of all, are especially characteristic of the human brain. For the first three weeks the eyes of the babe are aimless, and till the fourth month it recognizes only near objects. Baby Hall in the experiment recognized its mother in the ninth week at five feet distant; but objects at 50 feet not till the fifteenth week.

In short, man, like other animals, is living or to live in a physical world, for which the development of his physical being is a fundamental need; and his long period of infancy is made possible by the mammal adaptation, the secretion of milk; though the name "mammal" is from the Greek mamma, a breast, the milk-glands of the monotremes are modified fat or sweat-glands and discharge through pores on the under side of the body; these animals point back toward the reptiles in that they lay eggs with membranous shells, which in Echidna are carried in an abdominal pouch till hatched; in this pouch-carrying resembling the marsupials, (opossum, kangaroo, etc.) which are distinctly mammalian, but bring forth their young extremely immature; the begining of mental adaptation to parental care, is found also in egg-laying animals; in birds in general; in some batrachians; in the hymenoptera among insects; and exceptionally among fishes, as the stickleback and sunfish. In all those lower animals, from the fish downward, in which eating almost omnivorously and indiscriminately is the main business of life, and self-preservation not only the first but also almost the sole object, not only is little intelligence required but little is developed; hence we must not read into their actions human motives, or what such actions mean to us, but what they mean to them. The beginning of the care of the young in its most primitive form is found among the echinoderms, namely: certain starfishes which form a brooding cavity by bringing their arms nearer the body. Though such a feeling is milder than the ravenousness which does not even spare or discriminate its own species or its own offspring, there is a long space between this and true parental care which feeds and protects its offspring; which is accompanied by different degrees of intelligence and of affection, yet seems most distinctive in the higher ranks of animal life; bees, ants, and wasps, the highest of the insects, are equally distinguished above other insects for their apparent care of their young; yet this care, in the worker bee, incapable of being a mother, is not maternal. but the effect of a nursing instinct; which though it surpasses in perfection that of birds and mammals, is wasted by the Bembex wasp on the egg and young of the miltogramma fly, which, cuckoo-like has laid in the cell the wasp had prepared for its own; and the worker ants, still more intelligent, devour most of the eggs which they themselves have laid; and one species after taking care of the larva of the Lomechusa beetle as of its own, till it reaches the stage where it would bury its own, in following its instinct performs this act, which is fatal to the nursling on which it has bestowed so much care; and a bee will cover a cell from which the contents have been withdrawn, after depositing its usual quantity of honey, paying no attention to the considerable hole from which the honey has escaped: the care of the stickleback and sunfish is devoted to the nest, eggs and young, more intelligently, or less narrowly and mechanically than the hymenoptera; yet it is the male stickleback which gives this care, and also protection from the female; and advancing up the scale of intelligence, we reach creatures, in which instinctive action clearly does not end with itself, but acts like a trigger, mainly as the release or thrusting forth of intelligence. If affectionate care were wholly instinctive, we should expect to find some trace of it throughout the animal kingdom, and similar in degree in animals physically similar; but instead, we find it limited those animals whose young have a period of dependence; miss it entirely in most of the invertebrates and cold-blooded vertebrates; find it to vary with the class, among insects, that is, to be distinctive of hymenoptera; and even there, varies with the genus,—the solitary wasp laying its egg in the insect which is to be the food-supply of its young, instead of feeding it directly; in other words, an instinct results in the preservation of self or of the species of its possessor, and exists only as necessary to that end; in the case of the solitary wasp as compared with the bee, the preservation of the young is obtained by different means, or a different instinct, along a line of less resistance; perhaps explained by the fact that certain wasps are themselves insect-eaters, while the bee is vegetarian. All the variations upward point to intelligent adaptations to the situation; e. g. the difference between social and solitary wasps is not discovered from anatomical structure, not from greater affectional instinct in the former; the bee is indifferent to the death of its fellow-bees of the same hive, and sucks the juices of the bee-pupa accidentally killed; as some wasps cut up the bodies of dead relatives to feed them to their young; the social wasp solitarily begins its brood in spring; this first brood are worker imperfect females, held as children to their home since none can start a home of its own, and by a nursing instinct which devotes them to the care of the later broods and to nest-building for their common family. After looking at the behavior of the animal world nearest the plane of mere instinct, is not the evidence convincing, that affection, properly so-called, is not an original or primitive trait, but an acquired one? And higher, the English cuckoo and the American cow-bird indicate that the trait, because an acquired one, may be, and has been lost in these individual species, while the other species of the same genus retain it. The care of the young, among birds in general, is only seasonal, or even briefer in case of a second brood which displaces the first; a care of a few weeks, too brief, indeed, to be much remembered or reciprocated by the young bird; such care remains also in the mammals, emotional rather than intelligent; for a bitch has been known to cuddle slippers when its pups had been taken away, a marmoset monkey to adopt puppies, and apes, male as well as female to coddle puppies, cats, and rabbits, as well as offspring of other species of ape, though, unlike the cat and the bitch, they halt at the matter of feeding these pets, and bestowing the strong, tender and solicitous parental affection which is characteristic of apes and monkeys; which the young early recognizes sufficiently to cause it to cling trustingly to its mother.

And coming to the human species,—how much affection do we bring into life with us, if indeed, we bring any? Capacity for affection, a latent potentiality, the beginning of life may have; but there is a wide difference and distinction between capacity for a feeling, and the actual, manifestable possession of it. Mere capacity is an empty void, which may or may not be filled; for the powers of living, growing things, feeble at first, may be dwarfed or perverted. A man may become higher, "as the angels," or lower, "like the irrational beasts." Does not the order of Nature teach the way upward? Each child, in infancy so helpless, so dependent, springs from a mother, so that love precedes it into the world,—love the awakener, the teacher of love to the child. The longer the helpless period, the longer, the deeper, the more thorough the lesson of love as well as of intelligence. If mother-love can fail, we feel, as it were the foundations of Nature quaking beneath us. The mother has been, in her turn, the object of like love. Nay, even have not these parental affectional powers, in the human subject protracted into life-long exercise, by generations of perpetuation become transmissible tendencies?

As has already been premised, a certain degree of intelligence is found to precede the appearance in evidence of unquestionable affection, and is manifested by behavior, curiosity and the beginnings of imitation; but the first lesson of a creature finding itself in an unthinking, uncaring world of struggle for a living, if it has indeed escaped being eaten, is to take care of itself,—self-preservation; first by struggling like its fellow, for life and a living; next, from assault, it learns self-defence; cold and hunger teach the intelligence of the bee and the squirrel, providing for future as well as present needs. The occasion of this condition of mutual slaughter is the immense reproduction. The perpetuation of the whole animal world, the greatest opportunity to the greatest number, leaves but little to the individual, and that little depends mainly either on his power to overcome or his cunning in escaping; this is especially true of the ancient primal realm of animal life, the ocean. The elevation of the land above the waters, meant animal progress to the stage of amphibianism, by a process of natural selection or success of those water animals best adapted to become air-breathers and land-livers, the earliest amphibians being newt-like and appearing late in the Carboniferous period, with the rudiments of a cerebral cortex, the earliest indication of a form of nervous substance whose function is to elaborate psychical processes. The opening of the new realm, land, with a lessening of reproduction in most of its species, relieved its denizens from the pressure which narrowed the life of ocean animals, and destroyed the smaller or less-protected indiscriminately, best as well as poorest; and gave opportunity for a real and effective "survival of the fittest" or best-adapted for life in its environment, and for a development and broadening of the mental, and reaching upward to its culmination in man, by the progressive lengthening of the educable period, with the progressive increase of educability. The stimulus of objects presented to the five senses makes the child aware of his own existence by contact with other existences, kindling in his intellect an inextinguishable flame, the desire of knowledge; such object-lessons giving exercise to his powers, to lead him on from strength to strength, combining past with present acquirements of memory by the suggestions of association, ever calling him to the attractive work and duty of searching out and learning the reality, the truth, and the one great end of his being,—the highest development of true manhood. For this, eyes, ears, and thoughts are made.

Drawn out, meanwhile, by the influence and example of natural parental offection, the potentiality of affection becomes an actuality, growing with our growth; while the weakness of the child teaches it humility, and its conscious ignorance, docility or teachableness, through this consciousness of its own need and its impression of parental strength and willingness, yea, desire to help, coupled with its admiration of the stronger, and wiser parental helper, defender and instructor, whose kindness and compassion or sympathy are an impressive object lesson to it of those duties, and evoke gratitude and obedience because it loves and trusts. Further, as we mingle with our equals, we learn and add the duty of equals toward equals, those chosen ties, those high affections and friendships, gradually ascending to broad benevolence, the pure, just love which is the basis of morality.

For man's mind has moral, as well as affectional and intellectual powers. The duties which cluster about one's self offer numerous pleasing or otherwise profitable incentives to self; but the broader circle of duties to others, involving the seeking of their pleasure and benefit, calls for higher incentives without and nobler motives within the heart; yet self-sacrifice, and seemingly a degree of unselfish love is seen in the birds and beasts below man; in fact, every living being which has desires, is liable to have to do without or to give up the object desired; and every loving being is compelled by its own nature and the nature of things in general to self-sacrifice; and it is the more widely incumbent upon man according as his capability is the greater.

Among human affections, the one great competitor with parental affection is conjugal affection. The psychology of conjugality is chiefly connected with human beings, and chiefly important in its relation to them; though its physiology involves also certain classes of lower animals. In invertebrates, the transient physical attraction between separate sexes, as also in the lower vertebrates, is but a brief episode in the life-cycle. The reversion to hermaphroditic bisexualism, as high up the scale as the amphibians, is a tendency opposed to unisexualism, the basis of sexual attraction, which is that of one separate sex to the other; even cross-fertilization of hermaphrodite animals is not necessarily a proof of conscious attraction, since it is common in flowers, which are mostly, by analogizing them with animals, called hermaphrodite; though the so-called male and female plant-organs are really part of the sexless reproduction, and less correctly than in animals have the character of being either male or female, which is more than a mere differentiation of reproductive organs. Though mere physical sex-attraction may, in the history of evolution be more primitive, and therefore lower or less advanced than the nursing instinct, life-long conjugal affection is the latest flower of earthly evolution; and this is seen to be in accord with the rule that the characteristic appearing the later in the life of the individual coincides with that which is the later stage in the general biological evolution. Human tradition has made a few exceptions to its admitted rule that the lower animals have no permanent conjugal feelings; but observation is the only true guide; which contradicts tradition as to the lion, concerning which Ingersoll records that "the continuance of the union depends on the power of the male to hold his fickle spouse to her allegiance"; which accords with the habits of its class; as to the apes, the Africans objected to the advice that each limit himself to one wife, that they did not wish to be apes. Seasonal mating, which prevails among birds, is an advance upon mere copulation, and still more on the method of the female spider, which devours the male after his copulative function with her is completed. Eagles, hawks, owls, and ravens seem to mate permanently; other species are inferred to do so from returning to the same nesting-place year after year: yet circumstances alter cases here. Thus the wood-duck takes a permanent mate; excess of females results in polygyny among domesticated ducks; similar causes tend to produce similar results among many species of wild birds, as well as among animals, wild or tame, and among savages; a sequel often due to the loss of males in battle. A significant fact in this connection is that the male, so insignificant in size among the lowest animals, in proportion to the female, gradually makes a general approach to equality as we advance up to the fishes and snakes; and from the lizards upward, the proportion tends in his favor, and to the acquirement of the virtues and the faults of the stronger, displacing the female into the position and characteristics of the weaker. This greater size is, at least in some species, coincident with the longer embryonic period, and the later maturing of the male; e. g. in the horse and in man. In temperate climates, man reaches physical maturity, in general, at about 21 years of age; woman, at about 18. As already pointed out in the comparision of the chick and the child, the longer the plastic and educable period, the more favorable, under normal conditions, to the breadth of intelligence and education, and ripeness of mind and judgment. This is applicable to comparison of slow-maturing with early-maturing races, so that a woman of slow-maturing race may be broader in intelligence and riper in mind than a typical man of the earlier-maturing or child-race; though our main point is the general relative position of man and woman, or woman's place in Nature; and under that, particularly as man's mate and companion. As to the former, the typical woman is nearer the instinctive plane of mental action and feeling, or as regards the development of the individual, a little nearer the child-stage than the typical man is. She is more under the sway of feelings and emotions, and accordingly more variable in her moods, since feelings are variable. Man, conscious of strength, is more independent, open, self-reliant, and daring; has more of the physical fighting qualities. Woman, conscious of the limits of her strength, is more conservative, more restrained by public opinion and fashion.

As to the basis of marriage, it is, as Jesus placed it, in natural mating; "male and female created he them." It is a more intimate relation than that of child to parent; "For this cause shall a man leave father and mother and shall cleave to his wife; and they twain shall be (come) one flesh"; in other words, become permanently mated; for, notwithstanding the seemingly marked outward differences between adult man and woman, both are but differentiations from a common embryonic as well as a common evolutional base, and from a common human nature; mating being a necessity in order to the perpetuation of the species, is inferred to be ordained by the Creator, and is capable of growing into a firm and habitual union; normally it should grow up naturally, dating from an early stage of the mating feelings, as do other natural affections, e. g. that of child to parent, from the beginning or dawn of capability of such affection; unfortunately, the wandering, almost nomadic character of modern population gives little opportunity for normal growing together of man and wife, to which a thorough acquaintance acquired under natural conditions is necessary. "Flesh" in the New Testament, as in the prophets, very commonly means, the seat of the affections and desires; "they twain shall become one heart," is a fit rendering; and having become thus united, "What therefore God hath joined together, let no man put asunder." This "man" referred to, is primarily, the husband, who among te Jews had the prerogative of taking or of putting away the wife; a sacred covenant or betrothal, called "kiddushin," i. e. sanctification, being entered into between them, followed later by a feast, given by the bride's parents, the home-bringing of the bride to the bridegroom's house, and the handing of a marriage certificate to the bride; a writing of divorcement, in like manner was required for putting her away. Before the 14th century A. D. the presence of a rabbi was not required. As for the priest, his office was regarded as entirely remote from such matters, the law not mentioning him in such connection. Marriage derives its sanctity from the mutual consecration to it, of the pair united by it, and the strength of its bond from within the hearts, in the degree in which they are grown into one; it is absurdly self-contradictory to suppose "God hath joined together" persons who are not joined together in any true human sense, less even than chimpanzees or owls. Nature, through unnumbered ages has been pushing man forward to a plane and a position higher than that of fishes, reptiles, cats and goats. Mutual attraction "at first sight" there may be; love in any sense worthy of the name, necessitates acquaintance with the beloved, for it is nourished and grows on acquaintance: it is an outpouring, not an intaking; its chief joy is to benefit and make happy the beloved; it loves to love, and dreads the dissolution of the union much as one fears death; for only death or irresistible force can keep the pair apart; the opposite, where compulsion by canon law or any other, has to be used to keep the pair together, is a sham marriage. Where one leaves one mate, even in heart, for another, the marriage, if for the offending party it ever really existed, has by that one already been dissolved, by the most pronounced form of self-divorcement; and it would be a strange self-stultification of Jesus to condemn the species, adultery, and in the same breath to condone the genus, promiscuous unchastity, which includes adultery, and which he expressly excepts from condonation; and to compel a chaste person to the most intimate of all possible relations, with a harlot,—under the plea that this is necessary in order to avoid the committing of adultery. Matt. 19.4-9.

As mutual desire of two persons, each for some possession of the other causes an exchange or a sharing, so with minds right and fair the mutual benefits of association result in society and eventually, the State. We obey the law because it is equal, and equally for the good of all. But through association, affection is excited, obedience becomes the fashion or rule of civilized good society, and habitual; love of home, of kindred, broadens to love of country; the common rights of mankind are recognized; and men morally great among their fellows will rise to the plane of the higher duties, in obedience to the higher law of unselfishness, rectitude, honor, conscience. To him who is a faithful and honest learner, will teachings clear and copious, appear all around him. Example is the most powerful of teachers, and where is the age which has not had its multitude of noble examples? Where is the man who has not felt the influence of a grandly good humanity, personally illustrated, and in its mirror seen his own duty reflected? "All things whatsoever ye would that men should do unto you, do ye even so to them; for this is the law and the prophets." What, then, is this Golden Rule of morality, which makes us love our neighbor, our fellow-man, as we do ourself? This epitome of the moral law is, precisely, the lesson of our situation, as a man among men wonderfully like himself,—having the same natural rights of life, liberty, and the pursuit of happiness; rights limited by the rights of others. It is the fitting of one's self to his place, the harmonizing of one's self to his situation, the world.

For the great lesson , written in letters of stone and illustrated by fossils, in the geological history of countless past ages of adaptation of life to its environment, is that this earth is our place, our opportunity, to do our best in it, and to make the best of it, not to get well out of it, and as soon as possible, leaving our work undone. And whither should we go? Physics and astrophysics strongly indicate the unity as well as the universality of the physical forces as well as of the physical elements of the whole universe. Motion, as communicated by hammering iron upon an anvil, if rapid enough and long enough continued, results in heat of the iron; more rapid and longer continued, results in glow, increasing from redness to whiteness with increasing light; chemical action also results in heat; electrical force produces motion, heat, and light, and under certain conditions, magnetism; thus demonstrating the intimate relation of all these apparently different and distinct forces; in short, their mutual or co-relation; correlation of forces, a thread of unity connecting them all, as force transformed, but not destroyed. As to the material universe, the spectrum reveals, by their own light, the same material elements (as iron, calcium, and hydrogen) in widely sundered heavenly bodies as far as explored, including our sun and earth. And we may justly premise that the so-called natural laws, that is, constitutional principles, are the same in all worlds. ''What matter where, if I be still the same?''

''No biological generalization rests on a wider series of observations or has been subjected to a more critical scrutiny'' than the conclusion ''No life without previous life.'' ''Life only from previous life,'' says one of the highest physiological authorities (Huxley) is a principle ''victorious all along the line.'' Pasteur and Tyndall reach the same conclusion. ''The principle 'omne vivum ex vivo' is universally accepted by men of science.'' Cambridge Nat. Hist. v. 1, 1906. The fundamental life-plan or system again we find is unity; but because the energy is vital energy, the working out of the scheme results in immense variety; as if Nature were experimenting with every variety and form of life to obtain the best possible adapted of all; which harmonizes with the Platonic view that God could not at once produce the perfect ideal he had in his mind, because of the refractoriness of the earthy material from which he was producing the living world; only the scientist, observing the tendency even of improved animals to revert to lower ancestral types, as well as to deteriorate, would lay the stress upon the development of the individual; for the variation starts with the individual; the bodily variation, the characteristic of the invertebrates, (bodily plasticity being great where there is no internal bony skeleton, metamorphoses sometimes extreme, and the covering or shell sheddable and renewable) is accompanied by very slow advance in mind; thus while the ordinary estimate of the whole period since plant life began on the earth is about 28 million years, the vertebrates do not appear till near the end of the Palaeozoic period, estimated at 18 million years, leaving 10 million years from the amphibia to the present, of which 7 million reach to the appearance of mammals; the accelerated rapidity of mental development as we approach man, is indicated by the estimate, that of the 3 million-year period of mammals, man, according to Prof. G. F. Wright, has been on the earth only from 10,000 to 15,000 years. The increase in cranial contents, or size of brain, as we go higher, suggests that the increase is laid over the ancestral brain all the way around, as in a cubical ratio; if so, the conclusion of the anatomists was inevitable, namely, that man is not descended from any living species of ape, for the cranial contents of the gorilla brain are 600 cubic centimeters; of an Englishman of like body-weight, 1485 cubic centimeters, or nearly two and a half times as large, the increase being mainly in the cerebrum, or seat of the higher mental faculties, such as co-ordination of thoughts, perception of relation, as of cause and effect, reasoning. The great life-scheme does not find its consummation in mere repetition of life without advance; as witness what is called the law of irreversibility of evolution, namely, that lost organs of the lower stage are never recovered, but new organs are acquired. We discover in the individual, also, no repetition or second edition of the same kind of life, but a progressive development from stage to higher stage; thus the tadpole loses his fish-like characters, as gills, and becomes a frog; otherwise is not capable of reproduction, but dies out. The step from the inanimate to the animate is an upward one and a prophecy of further evolution,—that principle in the world of life causing a general tendency distinctly upward; not by indolent unuse of native powers, since one is necessitated by the constition of things as they are, to make the best possible use of the powers he possesses, or lose them and himself; not by disuse, for disuse of a natural power results in degeneration and loss of it; not in exhaustion of powers by abuse; for Nature never forgives a sin against one's self; nay, even innocent offspring inherit in the consequences, being robbed of their eugenic birthright, that is, the right to be well-born; the development results from the best exercise of our best powers, perseveringly followed. Thus the purpose or end of our existence is not pleasure or ease; these may be or may not be incidents of it, but the end is the developed manhood or womanhood, the best there is in us, and the nearest our perfection; and directly or indirectly the perpetuation of this perfection, eugenically or generally. And we, as human beings, are responsible for our use of ourselves and our powers; for not only is the nature of the living stronger than its environment, since it brings from the same soil and environment, the maple and the greenbrier, the noxious and the wholesome, much more in man, by far the most adaptable of earth-beings; bringing from the same Egypt the ancient Egyptians, one of the most deeply thoughtful and original of peoples, having one of the mightiest civilizations, and the stupid fellahs, and in corresponding south latitude in the same Africa, the Bushmen and the Hottentots, nearly the lowest of the race in intelligence and mode of life; but man, of all animals, has the most freedom of mind and of choice, in consequence of his greater mental breadth and versatility, and his supplanting of reflex action and instinctive action, by intelligent action, and of his individuality and personality, by virtue of which it is from the mind of the individual himself that motives derive their weight; that is, the individual mind originates its own sufficient (to itself) causes for action or volition; different minds being appealed to and moved by different motives, each mind according to its character generally; or according to the desire strongest at the time of willing, in individual instances; thus, the parent will labor and deny himself for the sake of his family; the miser, for the sake of acquiring money; the scholar, for the sake of learning; but most men for less permanent purposes and considerations. As in the case of protoplasm, the nature of the stimulus does not determine the character of the response; this last is, in man, determined by the individual responder. "The will is that kind of causality belonging to living agents in so far as they are rational, and freedom is such a property of this causality as enables them to originate events, independently of foreign determining causes." (Kant's Metaphysic of Ethics, chapter iii: Semple's translation, 3d ed. p 57; Abbott's tr., 3d ed. p. 65. Calderwood, Handbook of Moral Philosophy, p. 169.) "Will, an aspect of all developed mental life, rather than a single faculty." Ladd, Outlines of Descriptive Psychology, chap. xvii.

For ourselves, whatever we name the evolutive power which works through Nature,—the power which makes for betterment,—it is our duty, our interest, nay even the life and abiding happiness of ourselves and ours, to be and to act in harmony with it, beginning as early as possible that this course may become habitual, since character determines destiny; because also the powers unused are atrophied ere three-score years and ten, wrong habit has ossified into second nature, and the strength to overcome habit and begin anew vanished, never to return. This bringing ourselves into harmony with the power that makes for righteousness and betterment is the work of religion, which is not a form of words, mystic or cabalistic though they may be; nor is it a system of mere ceremonies. A parrot can imitate language, and a monkey, gestures. It is from the heart, not from the lips; yet man's conscience, being human, and therefore fallible, needs enlightenment. It is obligation, it is duty, it is right living and right thinking: solemnly earnest indeed, facing the fact that the process of our growth itself is, naturally and unavoidably, a continuous process of aging or hardening, whose natural end is death. To lose the sight is a great loss; so to lose the other senses; in death all the bodily senses, feeling included, are lost at once. What stimulus then can reach those who have lived only in the bodily senses, only of the earth, earthy, in their horizon, their range of perception, like the beasts? and what prospect when each shall "go to his own place?" When we have had our day, our round of experience, joyful or sorrowful, our place is filled by others, and so the broad principle of the greatest opportunity to the greatest number is carried out; teaching us the futility of selfish grasping of things we must soon relinquish entirely and forever. The impression of a continuation of life after death is originally and usually a projection from the habit of consciousness of being and having been continuously alive,—an impression most vivid among peoples of the lowest intelligence, as might be expected, since it requires no thinking, but the lack of it, and inability to draw an inference from the sight repeatedly of the breaking off of the signs and functions of life in others. "The aborigines of California, when first visited, were as near beasts as men ever become. The missionaries likened them to 'herds of swine, who neither worshipped the true and only God, nor adored false deities; 'yet the writer (Boegert) who paints the darkest picture of their condition remarks, 'I saw them frequently putting shoes on the feet of the dead, which seems to indicate that they entertain the idea of a journey after death.' Brinton, Myths of the New World, p. 234. The natives of Australia, who have no idea of God, believe that after death their souls mount to the clouds, or cross the ocean to a distant land. See D'Urville, Voyages, v. 1, p. 399. Other peoples put food on the grave, or weapons in it, for the dead man to use in the other world. In like manner, apparently, birds and animals accustomed to be pursued by a hunter, assume that the scarecrow image is a living man; though probably not mentally capable of imagining ghosts. The pretty Greek myth of Psyche, the soul issuing from the outworn body like a butterfly from a caterpillar chrysalis, is reversed by biological study, the marked bodily metamorphoses (which point back to the lower stages of animal life) taking place in the foetal beginning, not the end of life.

Science is looking for light on such problems more on the side of force than of form, and in the study of protoplasm. According to H. Spencer, A. R. Wallace, the Duke of Argyll and others, matter is the manifestation of force. Leibnitz' monad was a living atom, the simplest combination of soul and body; some more recent scientists have conceived that all living things have at least momentary sensation-consciousness, that is perceive sensations. Jacques Loeb, in his Comparative Physiology, 1900, rejects this use of the word "consciousness"; which he makes equivalent to "association-memory", and refers their theory to anthropomorphism, that is—attributing the same mental processes to lower animals as to men; and concludes from many experiments, his own and others', on lower animals, that the movements of the lowest animals are mainly from the same causes as plant-reactions, largely electrochemical. Contraction is produced by light in the one-celled spores of algae (seaweed), which certainly contain no nerve-ganglia; irritability and conductibility being common qualities of all protoplasm: and protoplasmic motions are due to changes in the physical character of the colloidal material in the protoplasm, either in state of matter, or absorption of water, or secondary changes derived from these. Rhythmical contractions we determine, not by the presence or absence of ganglia-cells, but by the presence or absence of certain ions (the general name for an-ions and cat-ions, the two elements of an electrolyte, (or compound decomposable by electric current), the first being developed by a current passing from the positive pole to the negative, the second by a current passing from the negative to the positive pole). If in the muscles of the skeleton the Na(=sodium) ions be increased, and the Ca(=calcium or lime) ions be reduced the muscles are able to contract rhythmically, like the heart. Most classes of invertebrates are heliotropic, that is, head toward the light, like the shoots of young plants, or geotropic, like the young root, with the aboral or tail end. Loeb holds that the characteristic positions of protozoa and coelenterates are tropisms, and their movements automatic reactions to sensation only, without true consciousness or true memory, as distinguished from bodily habit developed by exercise of bodily function; and that the reactions in worms are determined by the structure of the peripheral parts (those outside of the intestinal cavity) especially the muscles; the nerves and ganglia being only a quicker and more sensitive conductor of stimulus, and not centres but relay stations, and that each segment of the body in the articulates and lower vertebrates especially, furnishes its own innerving power; the bee abdomen severed will sting, the shark's headless body will swim; Goltz and Ewald kept a dog alive for years after removal of the spinal cord; the severed heart will beat for hours under proper stimulus; a frog, after removal of the whole brain and medulla, still moved its limbs coordinately and climbed; even the brain of the vertebrate shows its segmental character in the early embryonic stage; and he concludes from experiments as to sense of direction that "those determinative elements in the central nervous system, whose activity produces movements of the body have a fixed orientation (that is, point in a single definite direction) in the body, which evidently stands in some simple relation to the direction of the movement which is produced by it;" (suggestive of the magnet pointing to the pole, in effect, but not in cause); and from other experiments with excised brain in higher invertebrates and some vertebrates, that the action of the brain is inhibitive of movements. that is controls or restrains the restlessness characteristic of most of his subjects after they had recovered from the shock of amputation of the brain; and that activity is from stimulus, not from conscious need or intelligent wish as a rule among animals. The bodily activities (play) of young animals seem to corroborate this view; so hunger and pain. Physical sensation, painful as well as pleasureable, is due to specialized protoplasm or to the nervous system; it is logical to premise that susceptibility to the one kind means or involves susceptibility to the other, and could not be otherwise. Here again crops up a principle of compensation. Pain indeed has been misplaced beside death; but scientifically it is correlated with pleasure, as an incident of life only. Pain has played a definite and important part in general and individual evolution and education; for it stimulates us to better our condition; while pleasure makes us satisfied to remain as we are; thus hunger, progressing from disagreeable to distressing, is a stimulus to seek nutriment; without it no creature could preserve life, much less develop. Yet excessive excitement either pleasurable or painful, rapidly exhausts the nervous energy.

By the principle, "All life only from previous life," we are brought into the presence of an earliest originator of life for a universe, who (or which) cannot have the form, passions, senses or sense-limitations of a man, whose sight and hearing are limited to the range of a few miles; and the Constitution written in geological tables of stone, and in living tables of flesh is the test of human speculations (even though claiming divine authority) with which they must harmonize or be null. And we may see in Nature as well as in great men that power resides not in form, but in invisible force; the immense motive power in unseen electricity; the lightning-force in the invisible air, as well as the effects of impalpable light; so the beginning of life from microscopic elements; the immense intellectual motive power in a Plato, a Newton, a Franklin; the immeasurable moral motive power in a Jesus, a Paul, a Wesley. Man is not the centre of the universe; nor, by the principle of evolution is any man, as a special favorite of Heaven, enthroned god of the earth; but must descend into this arena of struggle to conquer or win his place; nor will men have eternal pleasure dropped upon them merely because they desire it; for there are many human desires universal, which for the most never end in fruition. The painful results, which look like punishments of our intellectual mistakes as if sins, indicate that our intellectual powers were just as much intended for use as our moral powers, such as faith and conscience; and faith is not credulity, but belief upon evidence the strongest we can get; and the test and measure of faith is its issuance in life and conduct, not in words. Does not Nature itself teach, by a world-full of object-lessons, yea, one of them the learner himself, that we cannot remain forever children, thoughtless, depending upon others' care? Yet through the ages there have been the miscalled ''mysterious providences'', which on logical analysis prove to be downright and unmysterious improvidences, due to heedlessness, rashness or foolhardiness, and ignorance. But the child's education is rendered compulsory by its own growth, and by the removal of its parents by death. Ignorant at first from lack of opportunity of time, it is obliged to develop in knowledge and in character. Nor is there place in the process of evolution for the sowing of ''wild oats'' by the individual; nor for selfish war, which kills those bravest, most able-bodied, fittest to survive and propagate their kind, but leaves those unfit for the struggle as the propagators, and to propagate their kind; a heinous transgression of the law of evolution, as well as of that higher law among the higher animals and men, the law of affection. Without love and sympathy there can be no heaven here or hereafter; and sympathy is born of thoughtful; kindness, under the stimulus of suffering by the sympathizer, which has softened the heart; and includes our fellow-creatures, even those of lower rank of being, as evolution pre-eminently teaches; the only way we may be sure of the better and more heaven-like is to begin it here and now; of such a life the acknowledged highest moral ideal is Jesus. The philosophy of evolution is clearly meliorism, the only hopeful and reasonable philosophy; the present system of things is not fixed, either at its worst or its best, but progressive upward, toward

> "One far-off divine event
> To which the whole creation moves."

The progress of mankind is mainly the progress of ideas, ideals and principles; its worst obstacles and evils, such as tyranny, cruelty, robbery, slavery of mind and body, vice, and selfish war, which involves them all,—have been of human creation, and therefore are removable by man, striving for the best, and inspired with courage and faith in its ultimate triumph. Man's work,—that which makes human life worth while,—is the becoming, and becoming something better and higher. And if in the plan of evolution and survival of the fittest, our abiding existence of some kind (necessarily higher) has place, it must lie in our harmony with that Power of evolution, through a life, a nature, a character fit and worthy to survive and be developed world without end. "To them who by patient continuance in well-doing, seek for glory, honor and immortality, eternal life." Such a hope is a bugle-call to the loftiest, noblest ambition and life-long effort. And as to the condition and associations:

By what they are, despite profession, men fall into congenial kinds;
For evil hearts invite perdition; but heaven shall come to heavenly minds.
What were heaven without the children, parents, loves and ties of home?
Walls of gems, and thrones, and splendor, cannot make that kingdom come.
Heaven lies not in things external; 'tis in souls and not in things.
Luxury is not supernal; angels are not made by wings.
'Mid the shadows, forms and faces of our unforgotten band;
Wireless messages, communings from their near world's borderland.
Lost the world, but love can reach them; life divine, the vital breath
Of man's mind, his germ, revives them in the silence after death.

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